SYNOPSIS OF RESEARCH PROJECT

ON

COMPARATIVE EVALUATION OF NATURAL, ORGANIC, CONVENTIONAL AND PRECISION FARMING IN BANANA CV. GRAND NAINE

UNDER THE GUIDANCE OF

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PRINCIPAL AND DEAN
COLLEGE OF HORTICULTURE
JUNAGADH AGRICULTURAL UNIVERSITY
JUNAGADH

SUBMITTED BY

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SYNOPSIS OF RESEARCH PROJECT

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9. Introduction

Banana (*Musa spp*.) is one of the most important fruit crops cultivated in India, owing to its high productivity, year-round availability, wide adaptability and significant contribution to food, nutritional and livelihood security. It occupies a prominent place in Indian horticulture due to its ability to produce high yields per unit area in a comparatively shorter period. India ranks first in the world in banana production and contributes a major share to global banana output. About 23 % of world banana are produced in India.

Banana and Plantains (*Musa spp.*) are one of the earliest crops having been domesticated by humans, so it is called as Adam' fig. Based upon its highest production potential and availability of the fruits to consumers, it is also called as 'Apple of paradise' and because of its versatility use in Indian food and also it is used good source of moisture, fiber, potassium, vitamins, carbohydrates and it's calorific value is 67-137/100 mg/g. Banana leaves are used as biological plate.

Banana is thought to be originated in the humid tropical regions of South-East Asia, with India recognized as one of its primary centres of origin. The present edible cultivars have developed mainly from two species, *Musa acuminata* and *Musa balbisiana*, along with their natural hybrids that were initially found in the rainforests of this region. By the seventh century AD, its cultivation had spread to Egypt and Africa, and today it is widely grown across tropical regions of the world, roughly between 30° N and 30° S of the equator. Being a tropical crop, banana requires an optimum temperature range of 20-30 °C for proper growth. Frost acts as a major limiting factor, while waterlogged conditions can promote diseases such as Panama wilt. Botanically, banana is a herbaceous, monocarpic and monocotyledonous plant and its edible portion is the starchy parenchymatous pulp (mesocarp and endocarp) with a berry type fruit.

In India, banana ranks first in production among fruit crops and occupies a prominent position in the horticultural sector. It is cultivated over an area of about 0.89 million hectares with a yearly output of approximately 37.6 million tonnes, contributing a substantial share to the total fruit production in the country. Among the major banana-producing states, Tamil Nadu leads with about 5064.69 thousand tonnes, followed by Uttar Pradesh (4687.87 thousand tonnes) and Gujarat (around 4400-4500 thousand tonnes), (Anon. 2024 a). Other important banana-growing states include Andhra Pradesh, Maharashtra, West Bengal and Karnataka.

In Gujarat, banana is an important commercial fruit crop, and the state is recognized as one of the leading producers with high productivity levels. Banana cultivation in Gujarat is primarily concentrated in the districts of Anand, Bharuch, Narmada, Vadodara, and Chhota Udepur. Among these, Anand district recorded an area of 7,493 ha with a production of 6,23,193 tonnes and a productivity of 83.17 t/ha, indicating highly efficient cultivation practices. The districts of Bharuch and Narmada also contribute significantly to the state's total production, with Bharuch exhibiting comparatively higher productivity among the major banana-growing districts. Overall, Gujarat maintains higher productivity (about 60-65 t/ha) compared to the national average, reflecting the acceptance of improved production technologies in the state (Anon. 2024 b).

Despite its importance, banana cultivation in India has increasingly become input-intensive. Being a nutrient-exhaustive and long-duration crop, banana requires substantial quantities of fertilizers, frequent irrigation, and regular plant protection measures to achieve high yields.

Green revolution transformed India from a state of food scarcity to self-sufficiency during the early 1970s. This shift in agriculture was achieved through the adoption of high-yielding varieties and hybrids, supported by amplified use of chemical fertilizers and pesticides, expansion of irrigation facilities and mechanization. However, intensive use of chemical inputs made crops more susceptible to insect pests and diseases. Keeping in mind that now it is high time to stop toxify our land and turn towards the sustainable farming especially for those crops which are the important in human dietary.

Natural farming is an emerging approach that emphasizes minimal dependence on external inputs by utilizing locally available resources such as farm-based organic formulations. It focuses on enhancing soil biological activity, improving nutrient cycling and reducing the overall cost of cultivation, thereby making farming more economically sustainable and environmentally safe. In this system, cow-based inputs such as dung and urine play an important role in the preparation of natural formulations with five *aayamas* of natural farming are; *Beejamrut, Ghan Jeevamrut, Jeevamrut, Achchhadana* and *Wapsa.* Which help to improve soil fertility, stimulate microbial activity and promote plant growth in a sustainable manner.

Organic farming aims to maintain ecological balance through the application of organic manures, biofertilizers and biological pest management practices. This system improves soil structure, enhances microbial activity and supports long-term soil fertility while ensuring the production of safe and residue-free fruits.

Conventional banana cultivation relies heavily on synthetic fertilizers, pesticides and herbicides to maximize productivity. While these inputs have improved yields, their prolonged use has led to soil nutrient imbalance, decline in soil organic carbon, reduction in beneficial microflora, environmental pollution, groundwater contamination and pesticide residue issues. In addition, rising input costs have increased the cost of cultivation and reduced farmers' profitability, making them more vulnerable to market fluctuations, especially small and marginal farmers. In this context, sustainable farming approaches have gained importance to conquer the limitations of chemical-intensive agriculture.

Precision farming represents a technology-oriented approach that ensures efficient and judicious use of agricultural inputs through site-specific management practices. Techniques such as drip irrigation, fertigation and real-time crop monitoring enable precise application of water and nutrients based on crop requirements, thereby improving resource-use efficiency and minimizing environmental impact.

10. Practical utility

The Green Revolution significantly enhanced agricultural productivity and ensured food security in India; however, prolonged and excessive use of chemical fertilizers and pesticides has resulted in deterioration of soil health, environmental pollution, and growing concerns related to food safety. These issues have raised serious questions regarding the long term viability of agricultural and horticultural production systems, particularly in high-input crops like banana. To improve farmers' income in real terms and ensure sustainability, restructuring of existing production practices along with supportive policy interventions has become essential. Consequently, reorientation of conventional banana farming towards more productive and sustainable alternatives has emerged as a priority, requiring integrated efforts among researchers, farmers, and extension agencies.

In order to meet the increasing demand for banana, farmers have largely depended on chemical-based inputs to maximize yields, leading to higher cost of cultivation and economic vulnerability. Indiscriminate use of agrochemicals has adversely affected soil physical and biological properties, nutrient balance, and groundwater quality in banana-growing regions. In this context, alternative farming systems such as natural, organic and precision farming offer potential pathways for sustainable banana production. Natural and organic farming emphasize soil health restoration and production of safe, quality fruits, while precision farming focuses on efficient input management, reduced chemical use, improved water-use efficiency and better weed control. A comparative evaluation of these farming systems in banana is therefore essential to identify sustainable, economically viable and environmentally sound production practices. Keeping in view the above facts, present investigation **"Comparative evaluation of natural, organic, conventional and precision farming in banana cv. Grand Naine"** is planned .

11. Objectives

1) To evaluate the effect of natural, organic, conventional and precision farming on growth and yield of the banana cv. Grand Naine
2) To study the effect of natural, organic, conventional and precision farming on quality of the banana cv. Grand Naine
3) To study the effect of natural, organic, conventional and precision farming on

soil properties

12. Review of literature

12.1 Natural farming

12.1.1 Effect on growth, yield and quality

Kavitha *et al.* (2022) evaluated the influence of *Ghan Jeevamrut* and liquid *Jeevamrut* on growth and yield parameters of banana (*Musa paradisiaca* L.) cv. Ney Poovan (AB). The results showed that the application of *Ghan Jeevamrut* @ 600 kg/acre along with liquid *Jeevamrut* @ 300 L/acre recorded the highest values for plant height (241.62 cm), pseudostem girth (62.32 cm) and number of leaves (15.65). The same treatment also produced superior yield attributes, including bunch length (58.33 cm), bunch width (30.47 cm), finger length (11.10 cm), finger girth (3.33 cm), finger weight (76.67 g), yield/plant (9.35 kg) and yield/acre (5.19 t).

Choudhary *et al.* (2023) did a study on pomegranate cv. Bhagwa. They applied *Jeevamrut* in combination with vermicompost. Results of experiment indicated that significantly maximum total soluble solids (13.54 °Brix), ascorbic acid (19.05 mg/100 mL juice), reducing sugars (9.68 %) and fruit volume (190.50 cm^3) were seen with application of *Jeevamrut* @ 16.08 L/plant along with vermicompost @ 24.79 kg/plant.

Mastiholi *et al.* (2024) conducted a study on guava continuously for three years to optimize the dosage and frequency of *Jeevamrutha* and resulted that higher dosage of *jeevamrutha* (1000 L/ha) applied at shorter interval (once in 15 days) recorded higher fruit yield (97.20 kg/tree and 17.30 t/ha), net returns (Rs.179710) and B:C ratio (2.08).

Chaudhari *et al.* (2025) studied the effect of various farming systems on banana production. The yield under *Jeevamrut*-based natural farming was found to be lower than FYM-based organic treatment (12 t/ha), indicating that *Jeevamrut* alone may not be sufficient to meet the nutrient requirement of banana crop.

Suthar *et al.* (2025) conducted a field experiment on banana cv. Grand Naine at Anand Agricultural University to evaluate the effect of natural farming inputs. The study indicated that the combined application of *Ghan Jeevamrut* @ 160 g/plant and *Jeevamrut* @ 160 mL/plant applied at 21-day intervals, along with green manuring, resulted in significantly improved performance. This treatment recorded higher fruit yield (90.73 t/ha), finger weight (161.01 g), bunch weight (29.40 kg) and number of fingers per hand (17.51), along with enhanced quality parameters such as ascorbic acid

(4.53 mg/100 g pulp) and total soluble solids (23.90 °Brix).

12.1.2 Effect on soil properties

Manjunatha *et al.* (2009) reported that *Jeevamrut*-enriched organic inputs improved soil physico-chemical and biological properties and also increased the effectiveness of applied FYM in sunflower. The beneficial role of *Jeevamrut* was mainly due to its ability to supply essential nutrients and act as a food source for beneficial soil microorganisms.

Reshma *et al.* (2017) observed that *Jeevamrut* @ 1000 L/ha significantly enhanced the community of nitrogen-fixing and phosphorus-solubilizing microorganisms compared to treatment without *Jeevamrut.* The results indicated that the collective impact of *Jeevamrutha* @ 1000 L/ha along with *Panchagavya* spray @ 7.5 % recorded even higher populations of N-fixers and P-solubilizers in cowpea.

Devakumar *et al.* (2020) take a trial on natural farming inputs. They applied *Jeevamrut* under different soil conditions. The results showed that *Jeevamrut* significantly improved soil microbial population (by about 2-3 times), nutrient availability, with nitrogen (276 kg/ha), phosphorus (34.2 kg/ha) and potassium (312 kg/ha) than control, increase of soil organic carbon (0.62 %) was also noticed.

Reddy *et al.* (2020) reported that maintaining optimum soil moisture (60-70 % field capacity, similar to *Wapsa* condition) significantly increased root length (18.6 cm), dry matter (42.5 g/plant) and water use efficiency (3.84 kg/ha-mm) compared to excess irrigation (13.2 cm and 2.71 kg/ha-mm, respectively).

Joshi *et al.* (2021) carried out a trial on cow-based natural inputs. Results appeared as application of cow dung and urine-based formulations significantly increased available nitrogen (312 kg/ha), phosphorus (28.4 kg/ha) and potassium (245 kg/ha) compared to control (268, 21.6 and 198 kg/ha, respectively).

Choudhary *et al.* (2022) showed that the organic treatment comprising *Jeevamrut* @ 16.08 L/plant along with vermicompost @ 24.79 kg/plant resulted in higher availability of nutrients, with nitrogen (290.07 kg/ha), phosphorus (25.58 kg/ha) and potassium (315.58 kg/ha). The same treatment also enhanced the soil microbial population, higher counts of fungi (23.68×10^4 CFU/g), bacteria (62.68×10^6 CFU/g) and actinomycetes (27.77×10^4 CFU/g) based on pooled data (2019-20) in pomegranate.

12.2 Organic farming

12.2.1 Effect on growth, yield and quality

Ghosh *et al.* (2014) investigated that among different organic manures, vermicompost at 20 kg/tree resulted maximum plant growth (0.31 m) height, (0.28 and 0.31 m) spread with quality fruits with total soluble solids (9.5 °Brix) and vitamin C content (77.2 mg/100 g) while FYM at 40 kg/tree applicated plants produced fruits with maximum total sugar content (5.80 %). However, the application of neem cake at 7.5 kg/tree found in the highest fruit yield (20.2 kg/tree) along with the production of larger fruits, with an average weight of 128.2 g in sweet orange.

Sau *et al.* (2017) investigated the effect of various nutrient sources, including chemical, organic and biofertilizers on mango (cv. Himsagar). The ttreatment involving biofertilizer (*Azotobacter chorococcum* + *Azospirillum brasilense* + AM (*Glomus musseae*) + *Panchagavya* 3 %) resulted highest fruit weight (237.12 g), yield (42.14 kg/plant) and improved fruit quality parameters such as TSS (19.70 °Brix) and total sugars (13.41%), along with an extended shelf life of up to 10 days.

Naik *et al.* (2021) evaluated the influence of different combinations of organic manures and inorganic fertilizers on custard apple cv. NMK-1 Golden. The results stated that the treatment comprising 25 % RDF + 75 % Vermicompost/plant was significantly superior with rest of treatments in terms of plant growth and establishment parameters.

Chauhan *et al.* (2024) stated that the application of 100 % N_2 as Vermicompost + *Jeevamrut* + *Panchagavya* + NPK Microbial Consortium in dragon fruit was detected significantly maximum no. of new branches/pillar (12.67, 16, 18.67 and 20.33) at 30, 60, 90 and 120 days after treatment, plant canopy spread (5.10 and 5.27 m2) at initial and harvest stage, number of flower/pillar (24), days taken from flowering to fruit harvest (29.93), number of fruits/pillar(19.33), fruit length (9.81 cm), fruit width (9.02 cm), fruit weight (390.85 g), peel thickness (3.65 mm), fruit yield per pillar (7.55 kg), fruit yield per hectare (8.38 t/ha), TSS (14.17 °Brix), ascorbic acid content (8.74 mg/100 g) and minimum titratable acidity (0.24 %).

Chouhan and Tripathi (2025) framed an experiment on winter season guava. The results disclosed that the combination of bio-enhancers and bio-fertilizers, as FYM (10 kg/tree/year) + Organic mulch (Paddy straw) + *Panchagavya* (3 %) + PSB (50 g/tree) + Azotobacter (50 g/tree), achieved the maximum yield (8.81 t/ha) recorded in

the same treatment.

12.2.2 Effect on soil properties

Korwar *et al.* (2006) revealed that the growth, yield and quality of aonla were markedly affected by various sources of nutrients. The joint influence of organic and inorganic nutrients increased the fruit yield and quality while, use of vermicompost improved the fruit quality. In addition, the soil physical, chemical and biological properties were influenced by sources of nutrients and tree.

Hiwale *et al.* (2010) reported that in sapota cv. Kalipatti, the highest nitrogen (N_2) content was observed with the 50:50 combination of castor cake and recommended fertilizers, whereas the maximum potassium content was recorded with 100 % FYM. Also, organic manures significantly improved soil moisture retention up to five months after the monsoon, with the highest moisture under the 50:50 FYM and fertilizer combination, succeeded by 100 % castor cake, as compared to the use of chemical fertilizers alone.

Shivakumar *et al.* (2012) managed a study to influence of organic manures on fruit yield and their effect on nutrient status of the soil in papaya cv. Surya. They came to an end that available major nutrients (NPK) were considerably elevated under the application of FYM equivalent to 100 % RDN (154.3) than control comprising chemical fertilizer as RDF.

Mir *et al.* (2013) observed that the collective application of biofertilizers (80 g/tree), vermicompost (20 kg/tree), FYM (20 kg/tree), green manure sunnhemp (*Crotalaria juncea* L.), along with the advised dose of NPK fertilizers in pomegranate significantly improved soil properties. This integrated treatment recorded maximum soil porosity (60.27 %), water holding capacity (60.31 %), bulk density (0.97 %), particle density (2.25 %), organic carbon (1.90 %), soil pH (6.89) and available nutrients including nitrogen (405.56 %), phosphorus (22.02 %) and potassium (419.00%).

Sharma *et al.* (2017) studied the effect of integrated nutrient management on soil parameters of custard apple cv. Arka Sahan field. The findings showed that the maximum water holding capacity (87.04 %), organic carbon content (0.82 %), available N (382.93 kg/ha), available P (25.13 kg/ha), available potassium (392.44 kg/ha) and minimum electrical conductivity (0.35 dS/m) and soil pH (7.2) were recorded under 50

% recommended dose of fertilizers along with 50 % N through vermicompost (766.5 g) supplemented with biofertilizers comprising Azotobacter (50 g), PSB (50 g) and VAM (20 g).

Singh *et al.* (2020) reported that soil physico-chemical properties showed marked improvement with the application of *Azospirillum brasilense* @ 50 g along with vermicompost @ 10 kg per plant in custard apple cv. Raydurg. Under this treatment, maximum values of soil porosity (50.22 %), organic carbon (0.55 %) and available nutrients were recorded, including nitrogen (344.30 kg/ha), phosphorus (42.44 kg/ha) and potassium (317.00 kg/ha).

Parmar *et al.* (2025) found that highest organic carbon (0.65, 0.77 and 0.71 %) in soil under organic farming during both the years (2022-23 and 2023-24) as well as in pooled, respectively in papaya cv. GJP-1.

Rikshita *et al.* (2025) analyzed soil parameters were significantly influenced by INM for increasing the organic carbon (0.73 %) and available phosphorus (44.07 kg/ha) by incorporation of 50 % RDF + 5 kg Vermicompost + 100 mL Azotobacter + 100 mL PSB per plant while, available nitrogen (315.78 kg/ha) and potassium (367.45 kg/ha) under 75 % RDF + 2.5 kg Vermicompost + 50 mL Azotobacter + 50 mL PSB per plant of custard apple cv. Sindhan.

Zankat (2025) concluded that among various farming system in brinjal, the maximum organic carbon (0.75, 0.78 and 0.76 %) observed in organic farming during 2023-24, 2024-25 as well as in pooled, respectively.

12.3 Conventional farming

12.3.1 Effect on growth, yield and quality

Goswami et al. (2012) executed an experiment on guava cv. Pant Parbhat. They discovered that in 2007-08 and 2008-09, plants grown with a half dose of RDF (250 g N: 195 g P: 150 g K) + 50 kg FYM + 250 g Azospirillum/tree/year produced the greatest annual increment in plant height (0.24 and 0.25 m), plant spread (0.58 and 0.66 m), trunk diameter (2.68 and 2.71 cm) and tree volume (0.055 and 0.041 m^3).

Monika *et al.* (2018) assessed the influence of foliar application of calcium and sulphur on the growth and yield of papaya. Their findings indicated that plants receiving spray of calcium [0.5 % $Ca(NO_3)_2$], sulphur (0.5 % K_2SO_4) and micronutrients (zinc sulphate @ 0.5 % and boric acid @ 0.1 %) along with the suggested dose of

fertilizers produced significantly superior results. This treatment recorded the highest number of fruits (34.21), fruit weight (1.39 kg), fruit length (29.96 cm), and fruit yield (47.54 kg per plant), which was about 28.21 % higher compared to the control.

Reche *et al.* (2019) evaluated the changes in physical, chemical and nutraceutical parameters of the jujube fruits 'Grande de Albatera' cultivar, grown under organic or conventional production systems. The findings indicated that organically grown jujubes were smaller in size, exhibited a slightly more vivid yellow and red coloration and contained higher levels of chlorophylls, carotenoids, sugars, organic acids and total volatile compounds, but had lower protein and flavonoid content compared to conventionally grown jujubes.

Parmar (2024) revealed that among the different farming systems in papaya cv. GJP-1 cultivation, the maximum height of plant (186.14, 182.86 and 184.50 cm), stem girth (31.06, 30.22 and 30.64 cm), number of leaves/plant (38.57, 36.96 and 37.76), number of fruits per plant (24.32, 26.13 and 25.22), average fruit length (19.29, 22.30 and 20.79 cm), fruit circumference (43.17, 48.72 and 45.95 cm), fruit weight (1.52, 1.68 and 1.60 kg), pulp weight (1.20, 1.33 and 1.27 kg), total soluble solids (11.17, 11.35 and 11.26 °Brix), yield/plant (35.03, 36.65 and 35.84 kg) and minimum days to fruit set (103.43, 102.37 and 102.90) were found in conventional farming during both the years (2022-23 and 2023-24) and pooled, respectively.

Pathania *et al.* (2022) performed an experiment to compare the influence of natural and chemical farming systems on apple production on soil, nutrient status of leaf and fruit quality. The results indicated that the mean fruit length (65.80 mm), breadth (71.62 mm), weight (159.65 g) and acidity (0.64 %) were higher in the chemical farming system (CFS) compared to the natural farming system (NFS).

Ganvit *et al.* (2024) revealed significant variation in growth and yield parameters with 100 % RDN + 0.5 % nano urea recorded the highest increase in tree height (87.00 cm), canopy spread in North–South (90.83 cm) and East-West (88.50 cm) directions. However, the highest number of fruits per tree (86.93), fruit yield per tree (15.27 kg) and yield per hectare (4.23 tonnes) were observed under 100 % RDN + 0.4 % nano urea.

12.3.2 Effect on soil properties

Gogoi *et al.* (2004) undertaken a field experiment during 2001-02 on banana cv. Barjahaji and reported that the application of Phosphate Solubilizing Bacteria (PSB) significantly improved the available phosphorus status in the soil. This enhancement in P availability promoted better growth and yield attributes. The effect was attributed to outcome of organic acids by PSB, which act as chelating agents and form stable complexes with Fe and Al commonly present in acidic soils, thereby releasing bound phosphorus into the soil solution and making it more accessible for plant uptake.

Kumar *et al.* (2020) compared natural and conventional farming systems in rice and sugarcane growing soils across 11 villages of Vizianagaram district, Andhra Pradesh. The study revealed that, in paddy soils, conventional farming recorded higher levels of soil organic carbon (SOC), available macronutrients (N, P, K, Ca, Mg and S), and slightly greater microbial populations including fungi, PSB, actinomycetes and *Pseudomonas spp.*, compared to natural farming. A similar trend was observed in sugarcane soils, where conventional practices resulted in higher SOC, available N, P, K, exchangeable Ca, Mg, Fe and Mn along with increased populations of bacteria, PSB and Pseudomonas spp., than natural farming.

Parmar *et al.* (2025) observed that the highest level of available nitrogen (231.76, 251.71 and 241.74 kg/ha), phosphorus (29.11, 34.96 and 32.04 kg/ha) and potassium (238.12, 254.53 and 246.32 kg/ha) in soil were recorded in conventional farming of papaya cv. GJP 1

12.4 Precision farming

12.4.1 Effect on growth, yield and quality

Patel *et al.* (2018) evaluated that divergent planting distance with fertigation on growth, yield and quality of banana cv. Grand Naine. Plants grown under planting distance 1.2 m x 1.2 m x 2.0 m pair row significantly higher yield (117.81 t/ha) than conventional planting distance. While, the maximum number of fingers/hand (20.44) and bunch weight (24.91 kg) were found significantly maximum with conventional method of planting 1.8 m x 1.8 m.

Hossain *et al.* (2019) examined the influence of bunch covering materials on shelf life and physio-morphological parameters of banana cv. Mehersagar. They seen that the blue polythene bag needed a minimum of 76.80 days for harvesting and a

maximum of 97.80 days for the control. The blue polythene bag had the highest bunch weight (19.90 kg), finger length (19.59 cm) and finger diameter (3.56 cm), while the control group had the lowest bunch weight (15.20 kg), finger length (14.57 cm) and finger diameter (3.07 cm).

Paradkar *et al.* (2023) disclosed that the use of silver-black plastic mulch in banana under drip irrigation resulted in a significant outcome in yield (84.45 t/ha), which was nearly 37 per cent higher than that obtained under conventional practices. The treatment also contributed to better water-use efficiency along with enhanced economic returns.

Singh *et al.* (2023) executed a field experiment in which banana bunches covered with non-woven polypropylene bags were evaluated against the farmer's practice of leaving bunches uncovered. The results indicated that bunch covering proved significantly superior in terms of all yield attributes. The treatment recorded the highest yield (455 q/ha) along with the lowest incidence of scarring beetle infestation (1.5 %) in the covered bunches.

Pramanik *et al.* (2024) undertake a field experiment on silty clay soil to assess the effect of deficit irrigation and reduced fertigation levels applied through drip in banana. The treatments included three irrigation regimes (50 %, 60 % and 70 % ETc) along with three fertigation levels (50 %, 60 % and 80 % of the recommended dose of fertilizers). The data showed that irrigation at 70 % ETc combined with 80 % RDF through fertigation proved most effective, resulting in a substantial increase in fruit yield in the mother crop (50.7 %) and the ratoon crop (55.7 %).

Zankat *et al.* (2025) executed a trial of different farming system in brinjal cultivation, she found maximum height of plant at 120 DAT (90.32 cm), fruits per plant (62.22), fruit weight (65.70 g), fruit length (6.98 cm), fruit diameter (5.74 cm), total soluble solids (4.86 ºBrix), fruit yield per plant (4.02 kg) and total fruit yield (87.59 t/ha) in precision farming in pooled (2023-24 and 2024-25) data.

12.4.2 Effect on soil properties

Tank and Patel (2013) experimented on the impact of fertigation on yield and nutrient status in soil and leaf of papaya cv. Madhubindu under South Gujarat conditions. They revealed that higher level of fertigation treatments maintained its superiority in improving soil properties such as available N, K_2O and organic carbon.

Hadole *et al.* (2020) observed that soil chemical properties were improved under fertigation compared to the conventional method of fertilizer application. In brinjal, the application of 150 % recommended dose of fertilizers through drip fertigation recorded significantly higher available nitrogen (266.56 kg/ha), phosphorus (18.98 kg/ha) and potassium (369.60 kg/ha).

Xavier *et al.* (2020) reported that integrating plastic mulching with fertigation practices enhanced soil health in banana cultivation improved soil properties by increasing soil organic carbon, available nutrients and microbial biomass in banana cultivation.

Pramanik *et al.* (2024) conducted a study in which drip-based irrigation at 70 % ETc supplemented with fertigation at 80 % RDF during the whole growing season resulted in improved soil organic carbon stock (34.1 %), the NPK content present in soil (31.9, 55.0 and 34.3 %, respectively) and plant NPK uptake (31.6, 32.5 and 16.9 %, respectively).

Zankat (2025) found the maximum available nitrogen (251.81, 261.94 and 256.87 kg/ha), available phosphorus (31.45, 34.50 and 32.97 kg/ha) and available potassium (288.48, 292.78 and 290.63 kg/ha) in soil under precision farming of brinjal during the year 2023-24, 2024-25 and in pooled, respectively.

13. Materials and methods

13.1 Location	:	Fruit Research Station, Madhadibaug, Department of Fruit Science, CoH, JAU, Junagadh
13.2 Year of Experiment	:	2026-27 and 2027-28
13.3 Experimental design	:	Large plot technique (CRD)
13.4 No. of treatments	:	Four (4) 1. Natural farming (NF) 2. Organic farming (OF) 3. Conventional farming (CF) 4. Precision farming (PF)
13.5 No. of repetitions	:	Six (6)

13.6 No. of plants/ treatment	:	Natural farming: 150 Organic farming: 150 Conventional farming: 150 Precision farming: 258
13.7 Spacing	:	Natural farming: 1.8 m x 1.8 m Organic farming: 1.8 m x 1.8 m Conventional farming: 1.8 m x 1.8 m Precision farming: 1.2 m x 1.2 m x 2 m (paired row)
13.8 Size of module	:	9 m x 52 m
13.9 Crop and variety	:	Banana and Grand Naine

13.10 Treatment details

13.10.1 Module-I: Natural Farming (NF)

- *Ghan Jeevamrut* 2.22 kg/plant + FYM 2.22 kg/plant at the time of transplanting (2000 kg/ ha
- Achhadan: Uprooted weed/crop residue
- Intercropping with turmeric
- Foliar spray of *Jeevamrut*
  1. *Jeevamrut* 5% at 1st month after TP
  2. *Jeevamrut* 7% at 2nd month after TP
  3. *Jeevamrut* 10% at 3rd to 7th month after TP
- Drenching of *Jeevamrut* 100 mL/plant from TP to 4th month of TP
- *Wapsa* condition
- Plant protection: *Agniastra, Brahmastra and Neemastra*, if required

13.10.2 Module- II: Organic farming

- Sole cropping of banana
- Organic mulch
- Vermicompost @ 5-8 kg/plant during vegetative phase
- FYM @ 10 kg/plant at 3rd and 5th month after transplanting
- Neem cake @ 1.50 kg/plant at 7th month after transplanting

- Azotobacter, phosphate culture and potash culture @ 50 mL/L water as soil drenching
- Plant protection: Trichoderma (50 g/plant), Pseudomonas (15-20 mL/plant) etc., as and when required

13.10.3 Module- III: Conventional farming

- Sole cropping of banana
- FYM @ 10-15 kg/plant and N:P:K @ 200:100:200 g/plant (three equal splits 3rd, 4th and 5th month of TP)
- Plant protection: Fungicides, insecticides and herbicides, as and when required

13.10.4 Module-IV: Precision farming (PF)

- Sole cropping of banana
- 150 g N and K_2O/ plant (325 g urea and 250 g MOP) through fertigation with 30 splits at 7 days of interval along with 5 kg FYM as a basal dose and 90 g P_2O_5 (560 g SSP) in three equal splits at 3rd, 4th and 5th months after transplanting
- Drip irrigation
- Plastic mulch (black- silver plastic mulch, 25 micron thick) at the time of transplanting
- Desuckering when required
- Sleeving of bunch with blue polythene bunch cover (135 cm x 75 cm, 18 micron thick) when finger start curl upward and after removal of male flowers
- Plant protection: Recommended fungicides, insecticides and herbicides through drone

13.11 Observations to be recorded

A. Growth parameters

i. Plant height (m)
ii. Girth of pseudo stem (cm)
iii. No. of leaves/plant
iv. Days to shooting (emergence of flower stalk)
v. Days to fruit maturity from shooting

B. Yield and yield attributing parameters

i. Weight of bunch (kg)
ii. Weight of hand (kg)
iii. No. of fingers/hand
iv. Length of finger (cm)
v. Girth of finger (cm)
vi. Weight of finger (g)
vii. Pulp weight (g)
viii. Peel weight (g)
ix. Average Yield/plant (kg)
x. Yield (t/ha)

C. Biochemical parameters

i. TSS (ºBrix)
ii. Total sugar (%)
iii. Reducing sugar (%)
iv. Non reducing sugar (%)
v. Shelf life (days)

D. Soil analysis

i. EC (dS/m)
ii. pH
iii. Organic carbon (%)
iv. Available nitrogen (kg/ha)
v. Available phosphorus (kg/ha)
vi. Available potassium (kg/ha)

E. Economics

1. Cost of cultivation

The cost of different treatments will be worked out by considering prices of labour employed for spraying of treatments and treatments cost.

2. Gross returns (₹ ha^{-1})

The gross realization in terms of rupees per hectare was worked out taking into consideration of fruit yields from each treatment and local market prices.

3. Net returns (₹ ha^{-1})

A net return of each treatment was counted by subtracting the total cultivation cost from the gross returns.

4. Benefit: cost ratio

The benefit cost ratio was worked out by using the following formula:

$$BCR = \frac{\text{Gross realization (₹ ha}^{-1})}{\text{Total cost of cultivation (₹ ha}^{-1})}$$

14. Statistical analysis

Statistical analysis of data of various characters will be carried out as per large plot technique. Analysis of variance will be worked out using completely randomized design standard statistical procedures as described by Panse and Sukhatme (1985). Statistical analysis will be carried out in the computer cell, Department of Agricultural Statistics, College of Agriculture, J.A.U., Junagadh.

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